striam 10. et marginem usque ad apicem), basi quoque (a scutello ad humeros) flavo; corpore subtus, pedibus antennisque nigris. Long. corp. lin. 2½; lat. lin. 2.

A species which may at once be recognized by its four flavous bands, each of which is broken, and, as it were, overlaps itself medially.

From the Chevrolat collection; received from the Cape of Good Hope.

[To be continued.]

XIII.—*Histological Researches on the Formation, Development, and Structure of the Vegetable Cell.* By Prof. H. Karsten.

[Continued from p. 36.]

§ X.

Formation of new joint-cells by the internal development of tertiary cells, and of the daughter cells contained within the secondary cells.—Folds in the wall of the mother cell.

In the different species of the genus *Spirogyra* the distinctness with which the changes just described as undergone by the endogenous cells may be recognized is very variable, and it appears even to differ in the same species at its different periods of development, or under different conditions of nourishment.

Although I observed a great number of *Spirogyræ*, it was especially in *S. nitida* and *S. orthospira* that I saw the development of the nuclear cell of which I shall here endeavour to give a general picture; and although this may be subject to modifications in detail for the different species, or their particular conditions of development, it nevertheless gives the certain result that in these plants also the cell-multiplication is effected by endogenous cell-formation, as indeed was to be expected.

If we trace, in the first place, the changes which are to be recognized in the cell-nucleus with its daughter cells, we have in the developmental condition represented in Plate VII.* fig. 85 an indication of the production of the septum in the mother cell by the flattening of the two daughter cells which enclose the nucleus of the mother cell between them.

The further development of this cell-system takes place usually as follows:—Simultaneously with the absorption of the nucleus of the mother cell new cells are produced in the daughter cells; the latter expand either in breadth, and then in the region of their central, contiguous and flattening walls, or in length; and at the same time their mother-cell membrane (the original membrane of the nucleus) seems gradually to disappear. The new nuclei of the two daughter cells are situated on their walls

* The Plate here referred to will be found in the June Number.

which are directed towards the extremities of the mother cell; between these and the septum produced by the mutually opposed membranes of their primary cells a system of mucilaginous filaments makes its appearance in the direction of their radii, indicating the formation in them of secretion-cells similar to those of the mother cell. These cells may be brought into sight by the action of dilute solution of tannin and of some other endosmotic fluids.

Upon the different directions of growth of the two daughter cells (*i. e.* whether they extend themselves more in the first or the second of the indicated directions) depends both the greater or less removal of the nuclei of the daughter cells from the median line of the mother cell at the appearance of the septum, and also the modifications in the mode in which this septum becomes visible at the surface of the joint-cell.

If the daughter cells at first follow especially the first indicated direction of growth, *i. e.* if they increase most in breadth, their central flattened walls attain the surface of the joint-cell, whilsttheir free peripheral portions directed towards the extremities of the mother cell scarcely form a hemispherical surface. These mutually flattened walls appear, on coming into contact with the wall of the mother cell, as the new septum.

The membranes of the secondary cell of the joint-cell, as also the chlorophyll-sac applied to their inner surface, cover the outer circumference of the septum, and even conceal it when a starch-vesicle or an opake chlorophyll-vesicle lies immediately upon it.

If, however, the daughter cells extend at first less in this direction than in the direction of their length, so that their free surface, instead of becoming hemispherical, approaches more or less to a spherical form, those phenomena occur which have hitherto been usually observed and described as the normal process.

In this state (in which the small secretion-vesicles surrounding the cell-nucleus are in process of absorption, and therefore collapse readily by any diosmotic process) the secondary cell, with the adherent chlorophyll-sacs, readily sinks down upon the more or less spherical daughter cells, which, however, always have a part of their surface flattened against each other, forming the depression which is frequently observed and regarded as a preliminary of the septum-formation.

That this fold-like depression is not essentially connected with the formation of the septum, but that it occurs only in a less complete and not perfectly regular course of development, appears from the circumstance that it is met with chiefly in cultivated plants, or in those which have grown in their natural

habitat when these have been long upon the slide, and brought into contact with different kinds of water.

A less degree of this depression appears, however, to occur even in plants growing in a natural state; and this is of interest here, because it induces the fold-formation which was formerly regarded as the cause of cell-multiplication, when the depression occurs at the precise period at which the two more or less spherical daughter-cells, touching the large secretion-cells with their peripheral surface, and hampered by these in their rapid growth, bring the previously free parts of their central surface into complete contact, and thus enclose this impressed membrane between them. The depth to which the folds of the secondary cell is enclosed in the septum in course of formation depends upon the greater or less extent of contact of the central surfaces of the daughter cells at the time of this process.

By a curvature or depression of one or the other of the chlorophyll-sacs, the side of the joint-cell is already perceptible, on which the liquefaction of the small secretion-cells situated about the nucleus takes place more rapidly than the enlargement of the neighbouring young joint-cells, which usually occurs simultaneously with it.

Newly formed septa not unfrequently occur, which on one side do not enclose the smallest trace of a fold of the mother cell between them, but show the well-preserved chlorophyll-sacs distinctly at their circumference (as represented in fig. 58 *a*, in *S. nitida*), whilst on the other side of the periphery of the mother cell a fold of this kind is engaged, more or less deeply, between the two plates of the septum.

These enclosed folds of the membrane of the secondary cell, which are no doubt subsequently absorbed, are at first thickened, reminding us of the folds of *Cladophora*, described at pp. 420 and 425 (vol. xiii.), as well as its peripheral portion, whilst the chlorophyll-sacs appressed to them are immediately absorbed.

The thickening of the membranes of the daughter cells, which takes place immediately, and their amalgamation with those of the mother cell commence in the portions forming the septum even before the completion of the absorption of the chlorophyll-sacs which surround them.

When the absorption of these secretion-materials is much delayed, the new, half-thickened septum may be seen, in certain positions, already united on each side to the membrane of the mother cell, after the joint-cell has been treated with endosmotic fluids, whilst it is still free beneath the chlorophyll-sacs. Figs. 74 and 75 show this in one sac.

But phenomena do occur which seem to show that in the *Spirogyræ* the development into new joint-cells does not always

belong exclusively to the cell-nuclei as above described, but that the two large secretion-cells (figs. 61 and 72) may constitute the foundation of the new joint-cells; in many species these show their relationship to the tissue-cells by their enclosing two large and often many smaller cells.

These two secretion-cells, which gradually become so much enlarged that at length they fill the whole cavity of the joint-cell (the other equivalent cells diminishing at the same time), consequently represent the two colourless, rapidly enlarging daughter cells, which become developed into new joint-cells, and which, in *Œdogonium*, may be recognized as being of this nature by direct observation throughout all their stages of development.

This, however, has not hitherto been possible in the case of the very fragile *Spirogyræ*, and hence we are compelled to combine many observations of details in order to obtain a connected picture of their mode of development; and in this errors are all the more likely to creep in, as the investigation of the development of the colourless cells in the interior of the joint-cells must be assisted by reagents, the mode of action of which is not yet satisfactorily ascertained.

Let us first consider those species in the elongated joints of which cell-nuclei are present, but do not appear to produce any daughter cells. If this be really the case, the new joint-cells in these species would be normally formed within the secondary cell of the joint-cell.

Fig. 74 represents a joint-cell of *S. Weberi*, which is divided into two halves by the newly formed, delicate, and still flat septum, whilst the chlorophyll-sac, completely coherent, is still closely applied to the inner surface of the mother cell, as has already been described in *S. princeps*. If this condition be observed for a few hours, we may see distinctly how the substance of the chlorophyll-sac, at its point of contact with the septum, loses its green colour, and finally becomes completely absorbed; in from four to five hours this process has advanced to the condition represented in fig. 76, in which the chlorophyll-sac is divided into two perfectly separate portions. At this time the septum does not yet exhibit any indication of the annular fold which is subsequently formed.

No doubt, during this absorption of the secretion-material of the mother cell, corresponding new formations take place in the daughter cells, but these cannot be observed here as in *Œdogonium*.

A phenomenon which is probably repeated in most young tissue-cells is, that the organized secretion-materials, and especially the starch and chlorophyll, adhere during their growth to

the inner wall of the membrane of the secondary cell, which is then likewise engaged in development. But afterwards, when a more active assimilative energy is acquired by the previously resting nuclear cell for the purpose of its progressive or retrograde metamorphosis, or when daughter cells are developed by the side of it, the secretion-vesicles separate from the wall of the secondary cell, and either float in the cell-juice or sink down upon the endogenous cells which are in a state of absorbent activity, and in the fluid contents of which new secretion cells are produced, at first floating in the cell-juice, but subsequently adhering to the inner surface of the secondary cell-membrane.

The vesicles in the products of decomposition of the contents of the mother cell and daughter cells, mentioned at p. 30, indicate the occurrence of such a regeneration of the secretion-cells, simultaneously with those of the endogenous tissue-cells. The vesicles containing chlorophyll, however, can never be proved with certainty to be at the same time contained in both the mother cell and the daughter cells. Under the conditions assumed, it seems to me that they would clothe the outer and inner surfaces of the membranes of the daughter cells in such a manner as to correspond with each other.

Moreover some phenomena seem to show that, simultaneously with the absorption of the chlorophyll of the mother cell, it is again re-formed in the enlarged daughter cells, which completely fill the mother cell (figs. 74 and 76); but these do not prove the fact quite satisfactorily.

Thus, simultaneously with the absorption of the chlorophyll-sac over the new septum (fig. 74), a new formation of chlorophyll is perceived near this spot, and, by this, a prolongation of the separated extremities is produced, of such a nature that the one extremity grows more to the right, and the other more to the left at the periphery of the new septum. This newly formed chlorophyll is always of a lighter green colour than the old sac, and of course does not contain the large starch-vesicles. That these are newly formed parts is evident, but it cannot be determined whether the appearances are due, as seems probable, to the prolongation of a new sac situated within the daughter cell beneath the old sac, or to the direct prolongation of the partially absorbed sac itself.

By the action of solution of glycerine or chloride of calcium upon cells in course of septum-formation (figs. 74 and 76), phenomena are produced very similar to those observed in the cell before division (figs. 78 and 79), but very different in their nature.

In the case represented in figs. 78 and 79, the delicate

secondary cell, with its internally adhering chlorophyll-sac, is contracted upon the two daughter cells as described at p. 29; it is finally ruptured between them in the middle, in common with the chlorophyll-sac, which is here likewise drawn out into a thread-like form.

In the developmental condition shown in fig. 75, it is the daughter cells, converted into new joint-cells (with their endogenous cells still nearly undeveloped and of equal size), that separate from their primary cell-membranes and contract upon the entire solid contents, their fluid contents being at the same time evacuated by exosmose.

The septum is quite uniformly thickened, and only perforated at the point where the chlorophyll-sac is situated,—not, however, in the centre of the septum, as must have been the case in accordance with the notion of septum-formation by an annular fold of the membrane of the mother cell constricting its contents, but, in correspondence with the position of the chlorophyll-sac before the action of the reagent, at its periphery.

This is seen very distinctly when the septum, formed by the mutual apposition of the endogenous cells, touches the chlorophyll-sac at the point where it contains one of the large thick-walled starch-vesicles, which requires a long time for its absorption. For if the septum strikes the chlorophyll-sac at a thin spot between its more solid contents, the sac is usually torn, during the action of the reagent, by the pressure exerted by it upon the membrane to which it adheres, the appearance being then as represented in fig. 77.

The thickening of the primary membrane of the daughter cell, which commences at the same time with the formation of the septum, as also that of the secondary membrane of the mother cell, advances from the septum towards the ends of the mother cell; and in consequence of this the remarkable phenomenon occurs, that the chlorophyll-sac at the ends distant from the septum is covered by a membrane (figs. 75 & 77), whilst near the septum (before its absorption) it lies freely upon the surface of the contracting endogenous cells.

This is probably explained by the fact that the secondary membrane of the mother cell, as also the primary membrane of the daughter cell, is no longer contracted by the above reagents in the immediate vicinity of the septum, as they have passed here from the soft and viscous into the compact and resistant condition; at some distance from the septum this contraction takes place, and therefore the membranes are ruptured at the limit between these two states of aggregation.

The soft and viscous state of the cell-membranes appears to me to be characteristic of the period of development which pre-

cedes the thickening of the cell-membrane. Before this transition-state the cell-membrane is more delicate, but more elastic; it then loses its elasticity, becomes thicker, appears to be swelled up and nearly gelatinous, and finally becomes again condensed and solid.

When the absorption of the chlorophyll-sac is completed above the new septum, it then probably advances towards the ends of the mother cell (the alteration of the membranes of the neighbouring cell-membranes and the production of new chlorophyll in the interior of the daughter cells going on simultaneously), and the contraction of the unthickened membrane of the daughter cell, in consequence of the action of dilute diosmotic fluids, exhibits the customary appearance, the separation of the membranes of the septum taking place at length, not in the centre, but in the periphery (figs. 76 & 77). It then presents a great similarity to those in which the mother cell is still undivided (figs. 78, 79). But in the former case the contracting membrane of the mother cell tears in the middle between the two contracting daughter cells; in the latter, if a rupture takes place, it is in the vicinity of the ends of the mother cell.

In order to explain this mode of formation of the septum by fold-formation, we should have to assume here that the fold of the membranes of the joint-cell grows through the cavity of the cell from one side to the other, commencing always from the side opposite to the chlorophyll-sac, and terminating at the opposite wall by applying itself closely thereto (figs. 74, 75).

In opposition to this supposition, I may state that I have never yet seen an ingrowing fold of this kind in the long and thin-jointed species which I have observed, but that I have very frequently watched the formation of the septum in all its stages, from the first moment at which it is recognizable as a delicate and scarcely measurable membrane stretched transversely across the cavity of the cell, with the perfectly continuous chlorophyll-sac passing close beside it as above described, up to the completion of the absorption of the latter at the boundary of the septum, which has in the meantime been increasing in thickness.

This mode of septum-formation by means of daughter cells of the secondary joint-cells occurs also in those *Spirogyræ* which contain several chlorophyll-sacs in their joint-cells, and perhaps quite as frequently as the one above described (p. 124) by the daughter cells produced in the nuclear cell.

In both cases the presence of several chlorophyll-sacs enables us to determine with perfect certainty whether, simultaneously with the production of the septum by endogenous cells, a fold-formation of the mother cell has or has not taken place. Even when the daughter cells of the secondary joint-cells formed the

new tissue-cells, I have frequently seen that all the chlorophyll-sacs lay completely continuous over the new septum.

In this mode of multiplication of the joint-cells the nucleus of the mother cells appears to be always absorbed, whilst new nuclei make their appearance in the new joint-cells.

I observed this mode of development chiefly in *S. decimina* and *S. nitida*. *S. orthospira* is less adapted to this purpose, on account of the delicacy of the walls of its chlorophyll-sacs. For my investigations I employed slides of very thin glass, so that by turning them over I could examine the object on both sides, with high powers, without disturbing its position.

Figs. 59–61 represent different states of *S. nitida* during this septum-formation.

In fig. 61 the two daughter cells, still destitute of nuclei, are somewhat contracted by dilute solution of glycerine, and covered by the membrane of the secondary mother cell, which is likewise contracted. The chlorophyll-sacs, which at this period frequently, although not always, lie parallel to the septum at the point of contact of the two endogenous cells, are here, after the contraction of the daughter cells, coiled up together over the nucleus of their mother cell.

In fig. 59 the nucleus of the mother cell was seen at *a* in course of absorption, and fixed in the new septum, which was surrounded on all sides by the chlorophyll-sacs.

Fig. 60 shows a somewhat more advanced stage of development: the new septum is here separated by the prolonged action of water containing carbonic acid, into two laminæ, the thickening of which had commenced, not from the whole periphery, but from one side. After the maceration of these cells in solution of chloride of calcium, the portions of the primary cells which were not yet thickened became much swelled, and acquired a deep violet-blue colour with iodine.

In the same specimens, as also in those cultivated with them, in which I detected, in this way, with perfect certainty, the multiplication of the joint-cells by endogenous cell-formation, I likewise frequently observed internal annular folds of the wall of the joint-cell, and with far greater distinctness than in the cases described in p. 125, as the folds here could be in general more readily distinguished, from their considerable thickness, which usually increases towards the central margin.

When this folding existed in the lowest degree, the non-nucleated daughter cells were developed in about the proportion shown in fig. 61; between them the wall of the secondary membrane of the joint-cell sank in, together with the unaltered and regularly adherent chlorophyll-sacs, so far as to form a fold of equal depth and breadth.

The other extreme of this fold-formation is represented in fig. 82, from a plant which had lain for some time in water containing carbonic acid; hence the thickening of the primary membrane of its joint-cells. The endogenous cells were here in complete apposition, forming a perfect septum. Squeezed in between them is a fold of the wall of the mother cell, which in this case did not grow regularly from the whole periphery into the cavity of the cell between the daughter cells, but only projected far into it in a part of its extent, whilst another portion of the circumference remained unaltered.

At this part, which was not affected by the folding, the chlorophyll-sacs, which were elongated simultaneously with the formation of the fold, are seen bent and crooked, as if they had been acted upon by a mechanical constriction. Others are separated into fragments, as in the normal formation of a septum. A joint-cell of this kind, seen from the side on which the fold is perfect, may readily be regarded as completely divided; and this illusion may be increased by the position of the new cell-nuclei, when, as in the case figured, they are large and filled with granular mucilaginous matter, situated in each of the new cells, not in the middle, as in the examples described at p. 125, but close to the new septum, and when seen in a particular direction appear like a cell-nucleus cut through by the fold.

It is rarely that, as in *Cladophora*, these folds appear to project freely to a greater or less distance into the cell-cavity; nevertheless I have repeatedly observed this on apparently perfectly healthy plants, especially of *S. orthospira*.

In diseased and dying plants, the joint-cells of which are often disproportionately short, the folds of the membrane are usually more developed, so that it would almost appear that the development of the two parts stands in a certain mutual relation.

These folds may be most readily seen when *Spirogyræ* are allowed to lie for a long time in water containing carbonic acid until all the endogenous cells of the joint-cells are destroyed. By the action of dilute endosmotic solutions, the membrane of the secondary cell then readily retracts itself, together with its still adherent chlorophyll-sacs, from the folded primary cell-membrane, producing appearances which would certainly appear well fitted to confirm the constriction-theory, if we were not undeceived by developmental history and analogy.

These folds, which occur in all degrees of breadth and difference of form, are, however, not destined to effect a multiplication of the joint-cells by the growing together of their central margin, any more than those of *Cladophora*, many of which

I observed unaltered for months together. This, unfortunately, cannot be done with *Spirogyræ*, some of which, however, I have been able to watch for several days before the death of the cell, without detecting any change of the fold.

For this reason it is quite inadmissible to regard the folds of the cell-membrane as abortive septa, at least as long as the production of such a septum by the amalgamation of the central margins of a true fold has not been demonstrated in a single instance, but, on the contrary, it has rather been observed that incompletely developed folds occur only as accompanying an endogenous cell-development taking place not altogether without disturbance, whilst in the normal development of the latter the newly formed septa are unmistakeably recognizable as endogenous productions.

[To be continued.]

XIV.—*Description of a Species of* Dolphin *found in the Orkney Islands.* By Alex. R. Duguid, M.D.

[Plate III.]

For many years I have heard the fishermen in this neighbourhood speak of a species of Whale, with white spots or stripes, which they frequently met with when in pursuit of the *Phocæna melas*, or Cääing Whale. The facility with which the latter is driven on shore is well known: hence the specific name which has been applied to it by some naturalists—*deductor*. But of the capture of the former species, though frequently chased, I have never heard of an instance till recently.

On the 21st of August 1858, several fishermen were pursuing their avocation in Scapa Bay, near Kirkwall, when, a shoal of whales making its appearance, all the boats went in pursuit. On approaching the whales, they were discovered to be the spotted or streaked species; and some of the pursuers desisted from all further efforts, expressing their opinion, from past experience, that it would be of no use attempting to capture them. Some of the boats, however, persevered, and having succeeded in getting a part of the shoal nearer to the beach, all again resumed the chase with renewed and vigorous efforts, and at last landed twenty small whales, which were speedily put to death by means of fishermen's knives and other lethal weapons.

I saw the whales on the evening of their capture. I knew them to be of a species which I had never seen before; but it was too dark to make an examination of them. I saw them again on the 23rd of August, and, having selected a specimen which was the least injured by the knives of the captors, I shall